International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

To Find Out Engine Performance Parameters for Neat Diesel Fuel and Ethanol Blended Fuel

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ABSTRACT

A lot of research work has been carried out using vegetable oil both in its neat form and modified form. Studies have shown that the usage of vegetable oils in neat form is possible but not preferable. The high viscosity of vegetable oils and the low volatility affects the atomization and spray pattern of fuel, leading to incomplete combustion and severe carbon deposits, injector choking and piston ring sticking. Methods such as blending with diesel, emulsification, pyrolysis and transesterification are used to reduce the viscosity of vegetable oils. Among these, the transesterification is the most commonly used commercial process to produce clean and environmentally friendly fuel. A large number of studies on performance, combustion and emission using raw vegetable oils and methyl/ethyl esters of sunflower oil , rice bran oil, palm oil , mahua oil, jatropha oil, karanja oil , soybean oil, rapeseed oil and rubber seed oil have been carried out on Compression Ignition(CI) engines. The purpose of this paper is to review previous studies that look into the effect of bio-diesel on CI engine from the viewpoint of performance, combustion and emissions.

Keywords: bio-diesel, vegetable oil, diesel, emulsification, pyrolysis, transesterification.

INTRODUCTION

The main purpose of fuel is to store energy in a form that is stable and can be easily transported from the place of production to the end user. There is an immediate need of alternative clean fuels, which is abundantly available as well as has lower impact of pollution than the present fossil fuels & conserve conventional fuel. In this regards the various alternative fuels like CNG, LPG, Propane, Bio-diesel, Ethanol, Hydrogen, Fuel cells etc. will help in the reducing oil import bills of an oil-dependent country like India and also help in reducing environmental pollution. In the current market scenario, every nation in the world is busy finding the substitute for the conventional fuels diesel and petrol.

The large increase in number of automobiles in recent years has resulted in great demand for petroleum products. With crude oil reserves estimated to last only for few decades, there has been an active search for alternate fuels. The depletion of crude oil would cause a major impact on the transportation sector. Of the various alternate fuels under consideration, biodiesel, derived from vegetable oils, is the most promising alternative fuel to conventional diesel fuel (derived from fossil fuels; hereafter just “diesel”) due to the following reasons.

- Biodiesel can be used in existing engines without any modifications.
- Biodiesel is made entirely from vegetable sources; it does not contain any sulfur, aromatic hydrocarbons, metals or crude oil residues.
- Biodiesel is an oxygenated fuel; emissions of carbon monoxide and soot tend to be reduced compared to conventional diesel fuel.
- Unlike fossil fuels, the use of biodiesel does not contribute to global warming as CO2 emitted is once again absorbed by the plants grown for vegetable oil/biodiesel production. Thus CO2 balance is maintained.
- The Occupational Safety and Health Administration classify biodiesel as a non-flammable liquid.
- The use of biodiesel can extend the life of diesel engines because it is more lubricating than petroleum diesel fuel.

Biodiesel is a kind of fuel produced by a process known asTransesterification. This is a process of transformation of one type of ester into another type of ester. Vegetable oil is a triglyceride. Glycerin isseparated from oil ester and alcohol is added and formed as alcohol ester

48known as bio diesel. Biodiesel or biofuel or esters of vegetable oil is a replacement of diesel fuel.Biodiesel is defined as the monoalkyl esters of vegetable oils or animal fats. Biodiesel is the best substitute for diesel fuels in diesel engines.The biggest advantage that biodiesel has over gasoline and petroleum diesel isits environmental friendliness. The production and utilization of biodiesel is facilitated firstly through the agricultural policy of subsidizing the cultivation of non-food crops. The higher heating values of biodiesels are closer to that ofthe petroleum products in the range of 39–41 MJ/kg which is slightly lowerthan that of gasoline (46 MJ/kg), petrodiesel (43 MJ/kg) or crude petroleum(42 MJ/kg), but higher than coal (32–37 MJ/kg).

Biodiesel burns similar to petroleum diesel as it concerns regulatedpollutants. On the other hand, biodiesel probably has better efficiency thangasoline. Important operating disadvantages of biodiesel in comparison withpetrodiesel are cold start problems, the lower energy content, higher copperstrip corrosion and fuel pumping difficulty from higher viscosity. This increases fuel consumption when biodiesel is used in comparison withapplication of pure petrodiesel, in proportion to the share of the biodieselcontent. Taking into account the higher production value of biodiesel ascompared to the petrodiesel, this increase in fuel consumption raises inaddition to the overall cost of application of biodiesel as an alternative topetrodiesel.

OBJECTIVE OF THE WORK

Objective of the project is to check the effect of various ethanol blends with diesel on the diesel engine without modification for investigating the performance and emission characteristics. Performance Curve and emission characteristics Using Alternative Fuels Ethanol And Biodiesel in Turbo charging Diesel Engine

1. Study of physical and chemical properties of diesel, ethanol and biodiesel fuels and their blends.
2. Ethanol is not miscible with diesel hence co-solvents like biodiesel is used to mix it and magnetic stirrer is used to mix all fuel-blends together
3. Diesel-ethanol-biodiesel blends are prepared in different proportions with magnetic stirrer and all blend samples are tested for physical and chemical properties.
4. These blends are compared with base diesel fuel to check its feasibility to use in existing diesel engine.
5. Blended fuels are tested in diesel engine to check the performance parameters like brake power, brake torque and specific fuel consumption and CO, HC, NO_x CO_2 emissions characteristics using 8 mode cycle. Performance and Emission characteristics plots are compared for conclusion.

Result:-

Introduction

To find out engine performance parameters there is requirement of engine observation data. This data is used to calculate different performance parameters like brake power, specific fuel consumption, emission etc. With the help of this performance parameters, the performance plots are plotted which gives characteristics of the engine under different load and speed conditions. In this chapter results are obtained for neat diesel fuel and ethanol blended fuel and comparison is made between two.

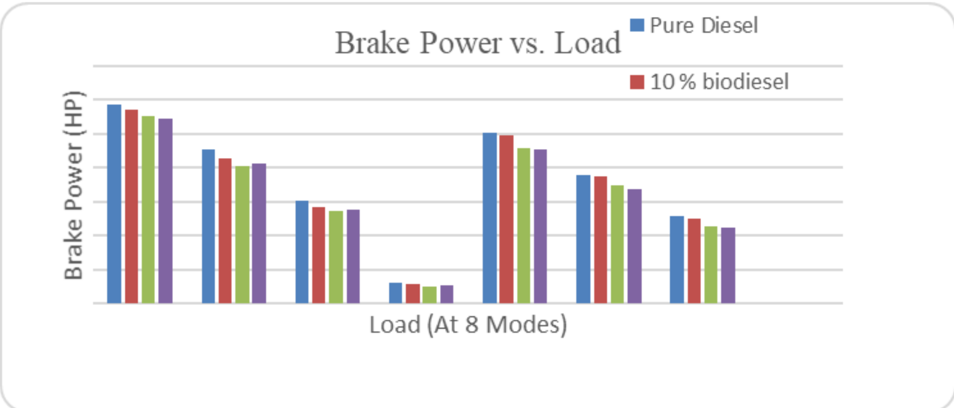

Fig. 1 Brake power vs. Load comparison for various 8 loads using different blends

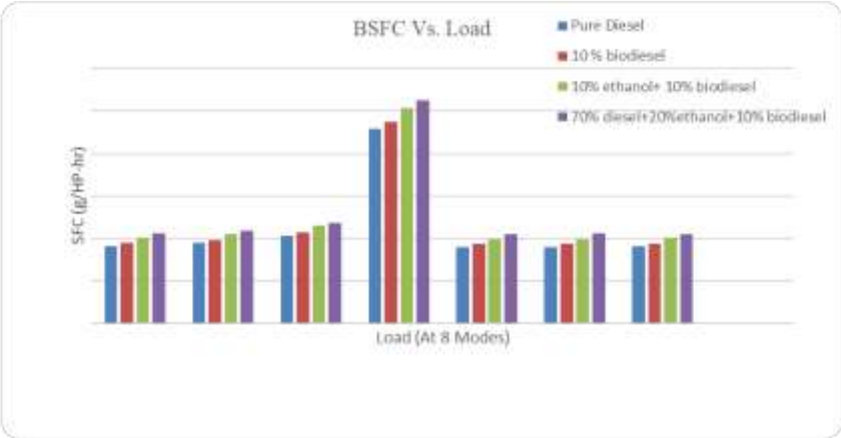

Fig. 2 BSFC vs. Load for various loads using different blends

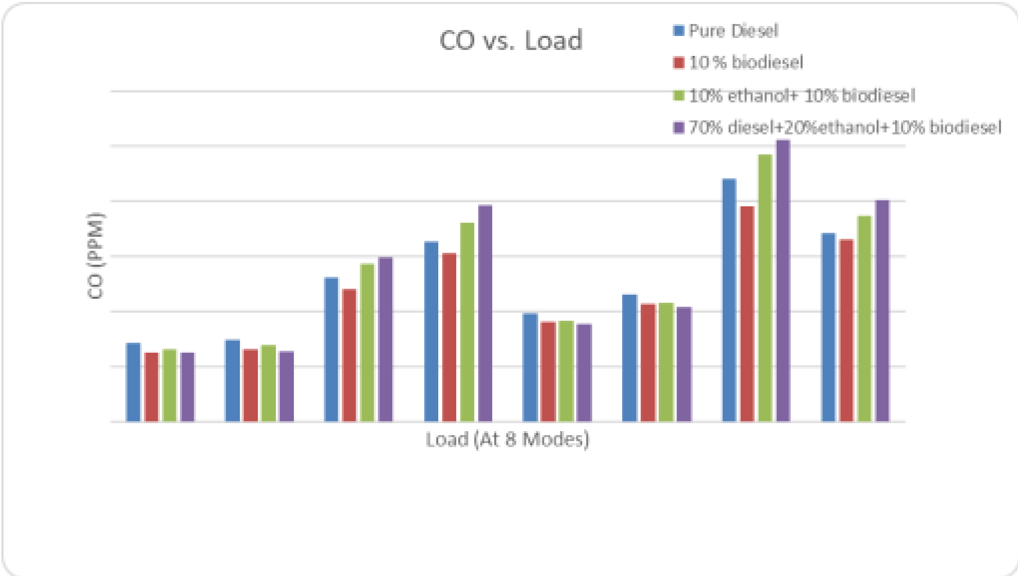

Fig. 3 CO vs. Load for various loads using different blends

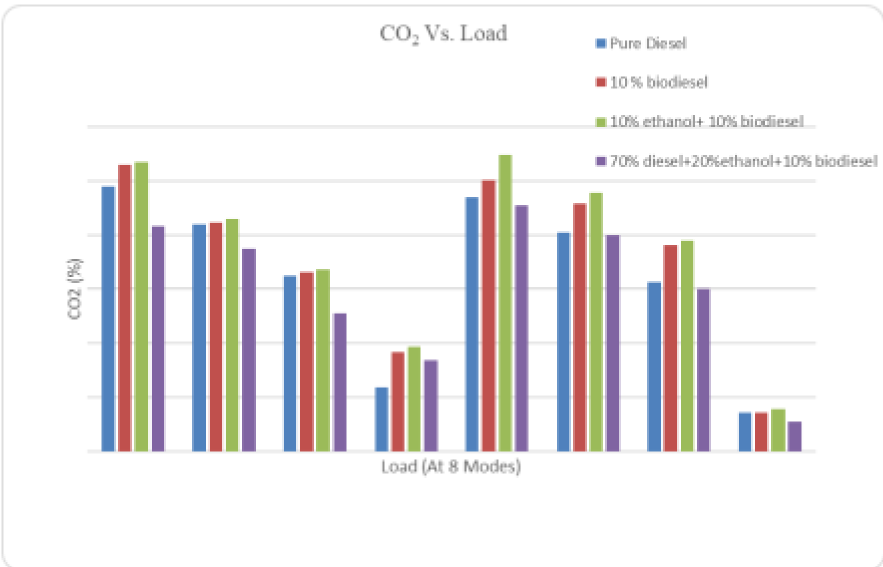

Fig.4 CO_2 vs. Load for various loads using different blends

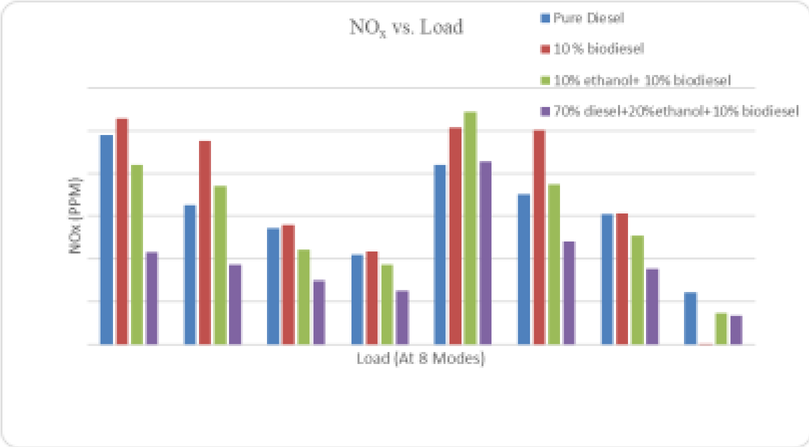

Fig. 5 NO_x vs. Load for various loads using different blends

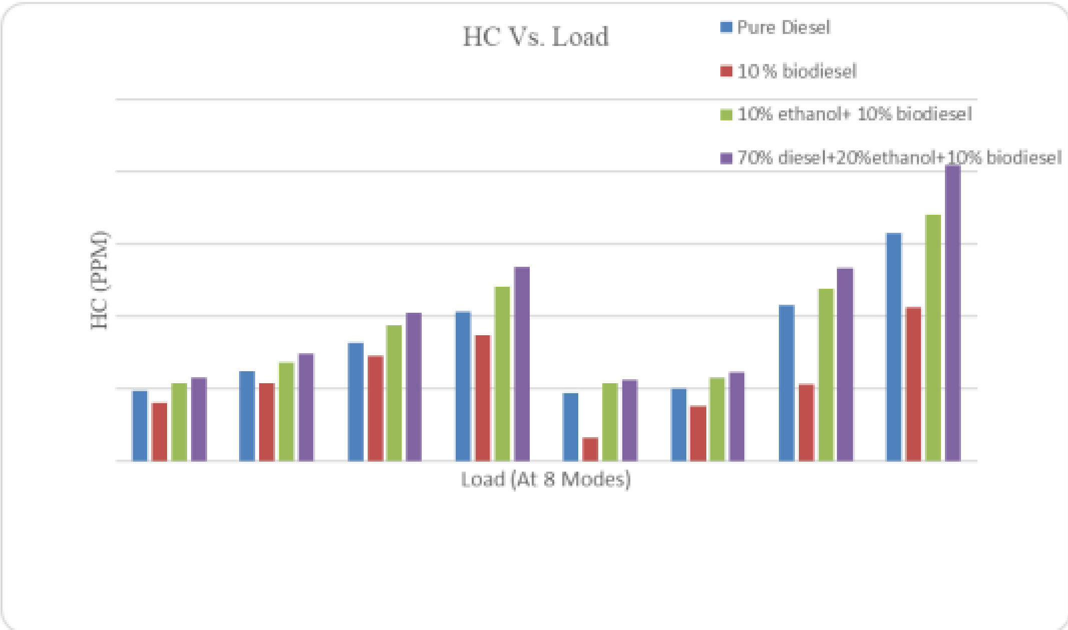

Fig. 5.7 HC vs. Load for various loads using different blends

6 Overall emission results using weight age factor

Table No. 5.8 Overall emissions for blends

	Neat Diesel	Blend DB10	Blend DBE10	Blend DBE20
HC (ppm)	83.245	60.35	92.915	104.27
CO (ppm)	252.8575	232.709	263.47	271.46
CO_2(ppm)	6.52	7.114	7.352	5.945
NO_x(ppm)	310.03	345.83	298.7	189.75

Concluding Remark

Blend DB10 is giving approximately same power and SFC because there is no large variation in calorific value between them, also blend DB10 is giving higher NO_x and CO_2 emission but it lowers CO, HC emissions compared with neat diesel fuel. Blend DBE10 slightly reduces brake power and slightly increases SFC. Blend DBE10 lowers CO emissions at 4 modes and increases HC emissions very slightly at all modes. A NOx emission lower marginally at 5 modes and remains approximately equal for remaining modes. CO_2 Emissions are slightly higher at all modes. For Blend DBE20, CO and HC increase for almost all modes. NO_x and CO_2 emissions reduces at all modes. From above discussion it is clear that NO_x emissions cannot be predicted exactly. Blend DBE10 has optimum performance and emission characteristics.

Conclusion-

Engine is tested for 8 modes cycle and effect of various blends on maximum brake power and maximum BSFC is as follows

1. Maximum Brake power for blend DB10, DBE10, DBE20 dropped by 2.86%, 4.94% and 7.37 % respectively compared with neat diesel fuel.
2. Maximum BSFC for blend DB10, DBE10, DBE20 increased by 3.37 %, 10%, 13 % respectively compared with neat diesel fuel.

Similarly emissions are measured for 8 modes for DB10, DBE10, DBE20 blends and percentage increment and reduction in emission with respect of diesel fuel are tabulated as follow

Table No. 6.1Engine is tested for 8 modes cycle

	Mode	1	2	3	4	5	6	7	8
Blend A	HC	-17.28	-13.07	-10.68	-15.77	-66.12	-24.02	-50.70	-32.64
	CO	-12.75	-11.39	-7.99	-6.33	-7.33	-7.35	-11.40	-3.22
	CO_2	+7.5	+1.07	+2.26	+3.56	+6.38	+11.37	+18.11	+0.69
	NO_x	+7.19	+31.5	+3.21	+3.66	+17.15	+30.33	+0.32	+1.53
Blend B	HC	+10.60	+8.37	+12.77	+14.13	+12.37	+12.67	+9.73	+9.83
	CO	-7.2	-6.79	+8.8	+9.83	-6.51	-6.53	+9.27	+8.38
	CO_2	+8.41	+2.44	+3.57	+3.9	+14.5	+15.09	+20	+8.33
	NO_x	-14.28	+11.94	-18.08	-11.42	+22.65	+6.66	-1.67	-39.32
Blend C	HC	+16.04	+16.62	+19.79	+21.21	+16.26	+17.97	+19.35	+23.08
	CO	-11.25	-13.64	+12.52	+16.51	-9.58	-10.95	+13.8	+17.52
	CO_2	-15.2	-10.86	-21.17	+30.18	-2.98	-1.23	-3.85	-23.07
	NO_x	-56.12	-42.6	-44.74	-40.05	+1.62	-31.57	-42.38	-45.06

HC emissions are found to be increased by 10.40 % and 42.12 % for DBE10 and DBE20 respectively. CO emissions are slightly increased by 4.03 % for DBE10 blend and reduced slightly by 6.85 %. NO_x emissions are reduced slightly by 3.65 % for DBE10 blend but increased by 38.8 % for DBE20 blend. CO_2 emissions are increased by11.31 % for DBE10 blend and reduced by 8.8 % for DBE20 blend. For DB10 blend HC, CO, CO_2 reduced slightly but NO_x increased substantially.

Amongst the blends which are tested on the single cylinder DI diesel engine, blend DBE10 is found the best from performance and emission point of view because

- Blend DB10 has higher viscosity (856 kg/m^3) which do not satisfy the IS 1448 regulations. Because of high viscosity fuel injector and filters can choke-up. Power consumption increases as high power is required to pump the fuel due to heavy oil. NO_x emissions regulations are in narrow range than other emissions and biodiesel blend has high NO_x emission than other blends.
- Blend DBE10 has optimum viscosity and calorific value which gives slightly less brake torque and brake power. Slightly increase in BSFC is found. It has cetane index 42.04 which is satisfactory. It has optimum emission performance for HC, CO, NO_x andCO_2 emission.
- Blend DBE20 has lower calorific value amongst the all blends. It has lower cetane index (25.58) which is very low. It increases ignition delay and degrades performance of the engine. Drop in brake torque and and brake power is high. BSFC is high due to lower heating value of blend.

In general it can be said that diesel-ethanol-biodiesel blends reduces NO_x, PM, Smoke with slight increment in HC emissions while keeping CO emissions at same level compared with diesel fuel.

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